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From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

DE BRUIJN, Leendert C. et al.  
NEDERLANDSCH OCTROOIBUREAU  
Scheveningsweg 82  
(P.O. Box 29720)  
NL-2502 LS The Hague  
PAYS-BAS

**PCT**

**NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

(PCT Rule 71.1)

Date of mailing  
(day/month/year) 22.01.2001

Applicant's or agent's file reference  
BO 42143

**IMPORTANT NOTIFICATION**

International application No.  
PCT/NL99/00583

International filing date (day/month/year)  
21/09/1999

Priority date (day/month/year)  
14/10/1998

Applicant  
ASM INTERNATIONAL N.V. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.


**4. REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/

 European Patent Office  
D-80299 Munich  
Tel. +49 89 2399 - 0 Tlx 523656 epmu d  
Fax: +49 89 2399 - 4486

Authorized officer

Hopwood, S

Tel. +49 89 2399-2429



## PATENT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents  
United States Patent and Trademark  
Office  
Box PCT  
Washington, D.C.20231  
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing:

20 April 2000 (20.04.00)

International application No.:

PCT/NL99/00583

Applicant's or agent's file reference:

BO 42143 YK

International filing date:

21 September 1999 (21.09.99)

Priority date:

14 October 1998 (14.10.98)

Applicant:

HASPER, Albert et al

1. The designated Office is hereby notified of its election made:



in the demand filed with the International preliminary Examining Authority on:

31 January 2000 (31.01.00)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer:

J. Zahra

Telephone No.: (41-22) 338.83.38

# PATENT COOPERATION TREATY

**PCT**

## NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

DE BRUIJN, Leendert, C.  
Nederlandsch Octrooibureau  
Scheveningseweg 82  
P.O. Box 29720  
NL-2502 LS The Hague  
PAYS-BAS

Date of mailing (day/month/year)  
09 March 2001 (09.03.01)

Applicant's or agent's file reference  
BO 42143 YK

International application No.  
PCT/NL99/00583

### IMPORTANT NOTIFICATION

International filing date (day/month/year)  
21 September 1999 (21.09.99)

1. The following indications appeared on record concerning:

☒ the applicant      ☒ the inventor      ☐ the agent      ☐ the common representative

Name and Address  
NOOTEN, Sebastiaan, Eliza  
Bosuillaan 303  
NL-3722 EX Bilthoven  
Netherlands

State of Nationality

NL

State of Residence

NL

Telephone No.

Facsimile No.

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person      ☐ the name      ☒ the address      ☐ the nationality      ☐ the residence

Name and Address  
NOOTEN, Sebastiaan, Eliza  
Bosuillaan 303  
NL-3722 XM Bilthoven  
Netherlands

State of Nationality

NL

State of Residence

NL

Telephone No.

Facsimile No.

Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office      ☐ the designated Offices concerned  
☐ the International Searching Authority      ☒ the elected Offices concerned  
☒ the International Preliminary Examining Authority      ☐ other:

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Authorized officer

R. Chrem

Facsimile No.: (41-22) 740.14.35

Telephone No.: (41-22) 338.83.38

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>BO 42143 YK</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/NL 99/ 00583</b>	International filing date (day/month/year) <b>21/09/1999</b>	(Earliest) Priority Date (day/month/year) <b>14/10/1998</b>
Applicant <b>ASM INTERNATIONAL N.V. et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

### 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.



as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.

3



None of the figures.

## INTERNATIONAL SEARCH REPORT

International Application No

P L 99/00583

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01L21/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 199 022 A (SHIMIZU CONSTRUCTION CO. LTD.) 29 June 1988 (1988-06-29) page 15, line 1 -page 15, line 20; figure 4 ---	1,2,4,5
A	US 4 776 744 A (STONESTREET ET AL.) 11 October 1988 (1988-10-11) the whole document -----	1,6

☐ Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

## \* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&amp;" document member of the same patent family

Date of the actual completion of the international search

10 December 1999

Date of mailing of the international search report

16/12/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Bolder, G

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PATENT L 99/00583

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2199022 A	29-06-1988	JP 1946661 C	10-07-1995
		JP 6071922 B	14-09-1994
		JP 63229278 A	26-09-1988
		JP 1946657 C	10-07-1995
		JP 6071921 B	14-09-1994
		JP 63134180 A	06-06-1988
		US 4867629 A	19-09-1989
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US 4776744 A	11-10-1988	NONE	
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REC'D 24 JAN 2001

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference BO 42143	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/NL99/00583	International filing date (day/month/year) 21/09/1999	Priority date (day/month/year) 14/10/1998
International Patent Classification (IPC) or national classification and IPC H01L21/00		
Applicant ASM INTERNATIONAL N.V. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 7 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 31/01/2000	Date of completion of this report 22.01.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Angermeier, D Telephone No. +49 89 2399 2283 



# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NL99/00583

## I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).):*

### Description, pages:

3-6 as originally filed

1,2,2a as received on 21/09/2000 with letter of 20/09/2000

### Claims, No.:

1-7 as received on 21/09/2000 with letter of 20/09/2000

### Drawings, sheets:

1/3-3/3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NL99/00583

- ☐ the description,      pages:  
☐ the claims,      Nos.:  
☐ the drawings,      sheets:

5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

**see separate sheet**

6. Additional observations, if necessary:

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. Statement

Novelty (N)	Yes:	Claims	1-7
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-7
Industrial applicability (IA)	Yes:	Claims	1-7
	No:	Claims	

2. Citations and explanations  
**see separate sheet**

## VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/NL99/00583

**Re Item I**

**Basis of the report**

- 1.0 The amendments filed with the letter dated on September 20, 2000 introduce subject-matter which extends beyond the content of the application as filed, contrary to Article 34(2)(b) PCT. The amendment concerned is the following:

The feature that the first and second cassettes are moved independently from each other to the sorting operation from the store has no basis in the originally filed application.

Consequently, the claim 6 does not fulfill the requirements of Article 34(2) (b) PCT.

In this respect, the subject-matter of claim 6 as originally filed is considered for novelty and inventive step analyses under Point V.

**Re Item V**

**Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

- 1.0 The following document (D) cited in the International Search Report is pertinent to this communication:

D1: US-A-4 776 744 (STONESTREET ET AL.) 11 October 1988 (1988-10-11)

D2: GB-A-2 199 022 (SHIMIZU CONSTRUCTION CO. LTD.) 29 June 1988  
(1988-06-29)

- 2.0 The present application does not meet the requirements of Article 33(3) PCT since the subject-matter of claims 1-7 does not involve an inventive step.
- 2.1 Regarding independent claim 1, Document D1, which represents the most pertinent prior-art, shows a device for sorting wafers which are stored in cassettes (cf. Figure 2 and column 7, line 40 -column 8, line 37),  
a) comprising a part for receiving (50) at least two cassettes (52 and 60) (cf. column 7, lines 64-68),

- b) and a wafer handling device (gripper 91 and indexer 81),
- c) the part for receiving the cassettes is arranged in a housing (load-lock 26) in which a store for cassettes and a cassette-handling device are arranged (40, 42),
- d) a wafer/handling device is provided for moving the wafers into and out of the cassette from and to the other cassette (cf. column 9, lines 18-29),

from which the subject-matter of claim 1 differs in that such a store for cassette and the cassette/handling device are separated from the part for receiving cassettes.

The problem to be solved by the present invention may therefore be regarded as enhancing the flexibility of the device.

The solution according to claim 1 is that such a store for cassette and the cassette/handling device are separated from the part for receiving cassettes.

However, this solution is rendered obvious by document D2 (cf. Figures 3 and 4 2nd paragraph on page 12) where the receiving part (48) is separated from the storage chamber (54) and the cassette handling device (96). The skilled person would therefore regard it as a normal design option to include the feature that such a store for cassette and the cassette/handling device are separated from the part for receiving cassettes, in the device described in document D1 in order to enhance the flexibility of the device.

Therefore, the subject-matter of claim 1 lacks an inventive step (Article 33(3) PCT).

- 2.2 Regarding independent claim 6, Document D1, which is likewise considered to represent the most relevant state of the art, discloses a method for assembling a (part of a) batch of wafers (cf. Fig. 2, column 7, line 40 - column 8, line 37) which is to be fed to treatment device of wafers (ion implanter scan wheel), comprising

- a) placing at least two cassettes (60 and 52) containing wafers in active connection with a wafer-handling device (gripper 91 and indexer 81),

b) whereby at least one of the cassettes is from a cassette store (40, 42),

c) the cassettes being moved from the store to a station in a housing (load-lock 26) (cf. column 7, line 64 - column 8, line 5),

from which the subject-matter of claim 1 differs in performing a sorting operation by moving wafers from one cassette to the other and vice versa.

The problem to be solved by the present invention may therefore be regarded as an alternative way of arranging the batch of wafers.

The solution according to claim 6 is performing a sorting operation by moving wafers from one cassette to the other and vice versa.

However, the solution of performing a sorting operation by moving wafers from one cassette to the other is rendered obvious by document D1 (cf. column 9, lines 18-29) where dummy wafers are transferred to the dummy cassette. For the skilled person it would be apparent to move the returned dummy wafers in the dummy cassette back to the original cassette where the dummies are stored in order to use them for the next batch of wafers. The skilled person would therefore regard it as a normal design option to include the feature of performing a sorting operation by moving wafers from one cassette to the other and vice versa in the method described in document D1 as an alternative way of arranging the batch of wafers.

Therefore, the subject-matter of claim 6 lacks an inventive step according to Article 33(3) PCT.

2.3 Dependent claims 2-5 and 7 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step (Article 33(3) PCT, the reasons being as follows:

a) The additional feature of claim 2 of arranging the wafer-handling device concerns a slight constructional change in the device of document D1 which comes within the scope of the customary practice followed by persons skilled in

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/NL99/00583

the art, especially as the advantages thus achieved can readily be foreseen.

b) The additional feature of using a measuring station functionally connected with the wafer handling device, is merely one of several straightforward possibilities from which the skilled person would select, in order to increase the throughput of the wafer production.

c) Document D1 shows respectively the additional feature of claims 4 and 5 ( cf. Figure 2, wafer carousel 40).

d) The additional feature of claim 7 of testing the wafers during the sorting operation, is merely one of several straightforward possibilities from which the skilled person would select, in accordance with circumstances, without the exercise of inventive skill.

**Re Item VII**

**Certain defects in the international application**

- 1.0 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D2 was not mentioned in the description, nor was this document identified therein.
- 2.0 The feature of the claims 6 and 7 were not provided with reference signs placed in parentheses (Rule 6.2 (b) PCT).

## Sorting/storage device for wafers and method for handling thereof.

The present invention relates to a device for sorting wafers according to the preamble of claim 1.

5           Such a sorting device is generally known in the prior art. If wafers are being treated batchwise, it is customary to include test wafers in a batch as well as end wafers wherein because they are used as "fill" in the batch, the quality of treatment of these wafers is lower due to the position in the treatment device, and these wafers cannot be used further, or can only be used further after they have been treated. If a batch of wafers  
10 comprises, for example, 100 wafers, they are fed in a number of cassettes to the appropriate treatment device, such as a furnace. Normally, such cassettes contain approximately twenty-five wafers, so that in such a case approximately four wafer cassettes are fed to the furnace. A number of these cassettes are filled only with "product" wafers. Moreover, a number of cassettes contain test wafers and the end wafers described  
15 above.

In addition to the sorting device, there are normally a separate storage device for cassettes and one or more separate measuring stations for carrying out measurements. This means that in the prior art three or more separate housings are present, each separately provided with a (wafer- or cassette-)handling device and a particle-free  
20 environment.

The wafers are handled in the sorting device and in the measuring stations in a particularly particle-free environment. Higher demands are placed on this environment than on a clean room in which wafers are transported in closed pods. From the moment at which the transport pod is opened and the cassette containing wafers is removed  
25 therefrom until the moment at which the cassette containing wafers is placed back in the transport pod and the transport pod is closed, this particularly particle-free environment has to be maintained. By providing the pod around the wafer cassette with a standardized door (SMIF, FOUP) and placing the cassette with this door against a wall of the sorting device with a closable opening and simultaneously opening cassette door and wall  
30 opening, it is possible to achieve a highly effective separation between clean room and wafer-sorting chamber. As a result, the demands which are imposed on the clean room can be of a low level, with a corresponding saving in the costs, while in the limited volume of the sorting device itself it is possible to maintain an environment which

satisfies the most stringent of materials requirements. It is also possible to provide the environment of the sorting device with an inert gas, such as nitrogen. The same applies to the measuring station. There too, the wafers are handled in a particularly particle-free environment. Each sorting station and each measuring station must be provided with a lock mechanism. The storage of wafers in the closed cassettes can take place under less stringent clean-room conditions.

US-4.776.744, from which the preamble of claim 1 is known, discloses a device for sorting wafers. A turn-table is present, having several blades on which an indexer is provided for holding and moving two cassettes. The blades can be moved below a wafer gripper for removal and introduction of wafers out and in the cassettes.

The object of the present invention is to provide a sorting/storage/measuring device which is easier and less expensive to produce and in which, moreover, the surface area required for the device can be limited without, however, reducing the throughput capacity. In addition, the flexibility is to be enhanced. The device as described above having the characterising features of claim 1. As a result, the sorting options are considerably increased, due to the fact that all the cassettes in the storage device are available to the sorting device. In addition, the necessary measurements can also be carried out during sorting without the need for transportation to a separate measuring station. Consequently, the number of handling operations decreases and the capacity of the device can be increased while reducing the surface area required. If the wafers are supplied and stored in cassettes in pods provided with a standard door (SMIF, FOUP), fewer lock mechanisms are required than with the three or more separate housings according to the prior art. If certain types of wafer are always present in a specific cassette, it is possible, by changing cassettes of this nature into a different cassette which is present in the sorting device, to assemble a batch as desired. Naturally, it is also possible to arrange different types of wafers in a storage cassette, so that exchange in the sorting device is less frequent.

It is possible for the sorting device to deal with more than two cassettes at a time.

According to an advantageous embodiment of the invention, the chamber in which the sorting is carried out comprises a measuring station or a measuring station is arranged in functional relationship with the wafer handling device. Preferably this



- 2a -

measuring station is provided in the space wherein sorting is realised or a measuring station is provided adjacent thereto. Such a measuring station may, for example, be designed to test layer thicknesses of the treated wafers, to measure the amount of

21.09.2000

(54)

Claims

1. Device (1) for sorting wafers which are stored in cassettes, comprising a part for receiving at least two cassettes (18, 19) and a wafer-handling device (24), the part for receiving said cassettes being arranged in a housing (2), in which a store (8) for cassettes  
5 and a cassette/handling device (25) are arranged, characterised in that, said wafer/handling device is provided for moving the wafers into and out of the cassette from and to the other cassette, and in that such store for cassette and said cassette/handling device are separated from said part for receiving cassettes.
- 10 2. Sorting device according to Claim 1, in which the said wafer-handling device (24) is arranged in a chamber (22) which can be sealed off with respect to the said housing (2).
3. Sorting device according to one of the preceding claims, in which said chamber  
15 (22) comprises a measuring station (16) functionally connected with said wafer handling device.
4. Sorting device according to one of the preceding claims, in which the part for receiving at least two cassettes comprises a turntable (30).
- 20 5. Sorting device according to one of the preceding claims, in which the said store (8) for cassettes comprises a rotatable magazine.
6. Method for assembling a batch of wafers in cassettes comprising placing at least  
25 two cassettes in active connection with a wafer handling device, said wafer handling device being used to carry out a sorting operation by transferring wafers from one cassette to the other, wherein said cassettes are from a store, and move from said store to said sorting operation by cassette handling device wherein a first cassette in the store is selected, and moved from the store to the sorting operation by said cassette handling  
30 device and a second cassette in the store is selected, and moved from the store to the sorting operation by said cassette handling device, characterised in that said first and second cassettes are moved independently from each other to said sorting operation from said store.

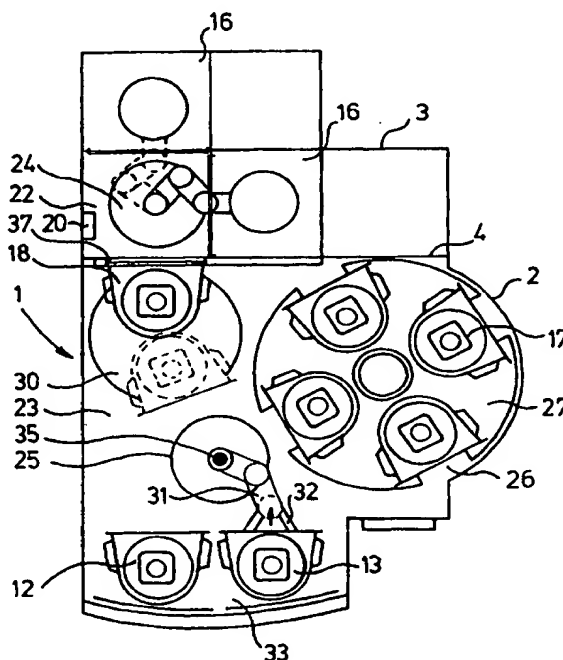
7. Method according to Claim 6, comprising testing said wafers during the sorting operation.

## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>7</sup> :</b> <b>H01L 21/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 00/22653</b> <b>(43) International Publication Date:</b> 20 April 2000 (20.04.00)
<b>(21) International Application Number:</b> PCT/NL99/00583 <b>(22) International Filing Date:</b> 21 September 1999 (21.09.99) <b>(30) Priority Data:</b> 1010317 14 October 1998 (14.10.98) NL <b>(71) Applicant (for all designated States except US):</b> ASM INTERNATIONAL N.V. [NL/NL]; P.O. Box 100, NL-3720 AC Bilthoven (NL). <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> HASPER, Albert [NL/NL]; Prinses Beatrix Plantsoen 9, NL-7941 EV Meppe (NL). NOOTEN, Sebastiaan, Eliza [NL/NL]; Bosuillaan 303, NL-3722 EX Bilthoven (NL). HENDRIKS, Menso [NL/NL]; I. Menkolaan 71, NL-3761 XK Soest (NL). <b>(74) Agent:</b> DE BRUIJN, Leendert, C.; Nederlandsch Octrooibureau, Scheveningseweg 82, P.O. Box 29720, NL-2502 LS The Hague (NL).		<b>(81) Designated States:</b> JP, KR, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>

**(54) Title:** SORTING/STORAGE DEVICE FOR WAFERS AND METHOD FOR HANDLING THEREOF**(57) Abstract**

Sorting/storage device for wafers. A sorting device is provided in which at least two cassettes containing wafers may be present and the wafers are moved from one cassette to the other cassette or vice versa. If appropriate, a measuring station may be present in the sorting device. In the immediate vicinity of the sorting device, the cassettes are stored in a magazine which is designed for this purpose and the cassettes are moved using a handling device for cassettes.



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Sorting/storage device for wafers and method for handling thereof.

The present invention relates to a device for sorting wafers which are stored in cassettes, comprising a part for receiving at least two cassettes and a wafer-handling device for moving the wafers into and out of a cassette from and to the other cassette.

Such a sorting device is generally known in the prior art. If wafers are being treated batchwise, it is customary to include test wafers in a batch as well as end wafers wherein because they are used as "fill" in the batch, the quality of treatment of these wafers is lower due to the position in the treatment device, and these wafers cannot be used further, or can only be used further after they have been treated. If a batch of wafers comprises, for example, 100 wafers, they are fed in a number of cassettes to the appropriate treatment device, such as a furnace. Normally, such cassettes contain approximately twenty-five wafers, so that in such a case approximately four wafer cassettes are fed to the furnace. A number of these cassettes are filled only with "product" wafers. Moreover, a number of cassettes contain test wafers and the end wafers described above.

In addition to the sorting device, there are normally a separate storage device for cassettes and one or more separate measuring stations for carrying out measurements. This means that in the prior art three or more separate housings are present, each separately provided with a (wafer- or cassette-)handling device and a particle-free environment.

The wafers are handled in the sorting device and in the measuring stations in a particularly particle-free environment. Higher demands are placed on this environment than on a clean room in which wafers are transported in closed pods. From the moment at which the transport pod is opened and the cassette containing wafers is removed therefrom until the moment at which the cassette containing wafers is placed back in the transport pod and the transport pod is closed, this particularly particle-free environment has to be maintained. By providing the pod around the wafer cassette with a standardized door (SMIF, FOUP) and placing the cassette with this door against a wall of the sorting device with a closable opening and simultaneously opening cassette door and wall opening, it is possible to achieve a highly effective separation between clean room and wafer-sorting chamber. As a result, the demands which are imposed on the clean room can be of a low level, with a corresponding saving in the costs, while in the limited

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## Sorting/storage device for wafers and method for handling thereof.

The present invention relates to a device for sorting wafers according to the preamble of claim 1.

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10 comprises, for example, 100 wafers, they are fed in a number of cassettes to the appropriate treatment device, such as a furnace. Normally, such cassettes contain approximately twenty-five wafers, so that in such a case approximately four wafer cassettes are fed to the furnace. A number of these cassettes are filled only with "product" wafers. Moreover, a number of cassettes contain test wafers and the end wafers described  
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30 opening, it is possible to achieve a highly effective separation between clean room and wafer-sorting chamber. As a result, the demands which are imposed on the clean room can be of a low level, with a corresponding saving in the costs, while in the limited volume of the sorting device itself it is possible to maintain an environment which

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volume of the sorting device itself it is possible to maintain an environment which satisfies the most stringent of materials requirements. It is also possible to provide the environment of the sorting device with an inert gas, such as nitrogen. The same applies to the measuring station. There too, the wafers are handled in a particularly particle-free environment. Each sorting station and each measuring station must be provided with a lock mechanism. The storage of wafers in the closed cassettes can take place under less stringent clean-room conditions.

The object of the present invention is to provide a sorting/storage/measuring device which is easier and less expensive to produce and in which, moreover, the surface area required for the device can be limited without, however, reducing the throughput capacity. In addition, the flexibility is to be enhanced. This object is achieved with a sorting device as described above, in that the part for receiving the said cassettes is arranged in a housing in which a store for cassettes and a cassette-handling device are arranged. As a result, the sorting options are considerably increased, due to the fact that all the cassettes in the storage device are available to the sorting device. In addition, the necessary measurements can also be carried out during sorting without the need for transportation to a separate measuring station. Consequently, the number of handling operations decreases and the capacity of the device can be increased while reducing the surface area required. If the wafers are supplied and stored in cassettes in pods provided with a standard door (SMIF, FOUP), fewer lock mechanisms are required than with the three or more separate housings according to the prior art. If certain types of wafer are always present in a specific cassette, it is possible, by changing cassettes of this nature into a different cassette which is present in the sorting device, to assemble a batch as desired. Naturally, it is also possible to arrange different types of wafers in a storage cassette, so that exchange in the sorting device is less frequent.

It is possible for the sorting device to deal with more than two cassettes at a time.

According to an advantageous embodiment of the invention, the chamber in which the sorting is carried out comprises a measuring station or a measuring station is arranged in functional relationship with the wafer handling device. Preferably this measuring station is provided in the space wherein sorting is realised or a measuring station is provided adjacent thereto. Such a measuring station may, for example, be designed to test layer thicknesses of the treated wafers, to measure the amount of



satisfies the most stringent of materials requirements. It is also possible to provide the environment of the sorting device with an inert gas, such as nitrogen. The same applies to the measuring station. There too, the wafers are handled in a particularly particle-free environment. Each sorting station and each measuring station must be provided with a  
5 lock mechanism. The storage of wafers in the closed cassettes can take place under less stringent clean-room conditions.

US-4.776.744, from which the preamble of claim 1 is known, discloses a device for sorting wafers. A turn-table is present, having several blades on which an indexer is provided for holding and moving two cassettes. The blades can be moved  
10 below a wafer gripper for removal and introduction of wafers out and in the cassettes.

The object of the present invention is to provide a sorting/storage/measuring device which is easier and less expensive to produce and in which, moreover, the surface area required for the device can be limited without, however, reducing the throughput capacity. In addition, the flexibility is to be enhanced. The device as described above  
15 having the characterising features of claim 1. As a result, the sorting options are considerably increased, due to the fact that all the cassettes in the storage device are available to the sorting device. In addition, the necessary measurements can also be carried out during sorting without the need for transportation to a separate measuring station. Consequently, the number of handling operations decreases and the capacity of  
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It is possible for the sorting device to deal with more than two cassettes at a time.

30 According to an advantageous embodiment of the invention, the chamber in which the sorting is carried out comprises a measuring station or a measuring station is arranged in functional relationship with the wafer handling device. Preferably this

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undesirable foreign particles which are present on/in the wafers and the like.

The cassette-handling device is able to move the cassettes from the insertion position to the store or to a turntable. The turntable moves the cassette into the correct position for the lock mechanism via which the cassette is placed in active connection  
5 with the wafer-handling robot.

The store for cassettes may comprise any structure which is known in the prior art, such as a rotatable magazine.

The invention also relates to a method for assembling a (part of a) batch of wafers which is to be fed to a treatment device for wafers, comprising placing at least  
10 two cassettes containing wafers in active connection with a wafer-handling device and using the said wafer-handling device to carry out a sorting operation by moving wafers from one cassette to the other and vice versa. According to the invention, this method is characterized in that at least one of the said cassettes is from a cassette store, the said cassettes being moved from the said store to the sorting station in a housing.

15 According to an advantageous embodiment of this method, the wafer is subjected to a measurement during the sorting operation. "During" is also understood to encompass immediately before or immediately after the sorting operation.

The invention will be explained in more detail below with reference to a structure according to the prior art and an exemplary embodiment according to the  
20 invention. In the drawing:

Figs. 1a-c very diagrammatically show a number of devices according to the prior art;

Fig. 2 shows a diagrammatic, perspective view of a sorting/storage device according to the invention; and

25 Fig. 3 shows a plan view of the various parts of this device according to the invention.

In Fig. 1a, 40 denotes a sorting device which comprises a part (depicted highly diagrammatically) in which the cassettes 12 and 13 are arranged and a device for handling wafers which is denoted by a circle 41. Using this device, wafers, for example,  
30 are removed from cassette 12 and placed in cassette 13 in any desired order.

Fig. 1b shows a storage device 42. A store is denoted by 43 and a cassette-handling robot is denoted by 45. Using cassette-handling robot, cassettes 12, 13 are moved from the insertion position into store 43.

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Fig. 1c shows a measuring station 44 with a diagrammatically depicted measuring cell 45. Wafers from the cassette 12 are subjected to a specific measurement in measuring cell 16.

To carry out a treatment in, for example, a furnace, such as a deposition process on a wafer, firstly, if required, measurements are carried out on test wafers in one or more measuring stations 44, for example the number of dust particles present before the treatment is measured. Then, a batch is assembled in device 40. Cassettes 12 containing different wafers which are required for this purpose come from store 42. After the appropriate treatment has been carried out, the wafers are sorted again in station 40 and are stored in station 42. The test wafers are measured in one or more measuring stations 44.

Transport between the various stations takes place in the cassettes 12, 13 and is taken care of by various operators or by a cassette-transporting system.

Figs. 2 and 3 show the single device according to the present invention which combines the above devices and considerably simplifies the complicated operations while allowing more efficient handling of the wafers on a much smaller surface area.

In these Figures 2, 3, a sorting/storage device according to the present invention is denoted by 1. This device is arranged in a housing 2. This housing 2 is preferably itself placed in a chamber which is not shown, such as a clean room.

As can be seen from Figs. 2 and 3, the housing is provided with a partition 4. Partition 4 provides a separation between chamber 23 and chamber 22. A cassette-handling device 25 such as a robot, and a magazine 8 for cassettes are situated in chamber 23. Communication with chamber 22 is realized via closable opening 37 which is designed in such a manner that, when cassette 18 is placed against it, both this cassette and the said opening 37 are opened. Consequently, it is possible for the wafer-handling device or wafer robot 24 arranged in chamber 22 to collect wafers from the cassette in question or to position them therein. This wafer-handling robot 24 is able to move both in the horizontal plane and in the vertical plane and is controlled by control unit 20. Any desired gas atmosphere can be maintained within a chamber 22, for example a pure nitrogen atmosphere, in order to avoid any action on the wafers, and the number of particles can be reduced still further.

Moreover, one or more measuring stations are situated adjacent to chamber

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22. Each measuring station is able to determine one or more different parameters, such as the layer thickness of material which has been deposited on the wafer, the chemical and/or physical state of this material, the number of dust particles on the wafer and the like. As can be seen from Fig. 3, measuring stations may be placed in active connection with the wafer-handling robot at a number of positions. Moreover, it can be seen from Fig. 2 that if the height of the measuring stations is limited, two or more measuring stations can be placed above one another within the reach of the wafer-handling robot.

These cassettes 18 are arranged on a turntable 30. Using cassette-handling device 25, cassettes can be moved from this turntable 30 to store 8. This cassette-handling robot 25 comprises a jointed arm 31 and a height-adjustment mechanism 35. Store 8 comprises a rotatable, cylindrical magazine provided with receptacles 26, at different levels 27, which receive cassettes 17. Cassettes 12, 13, 17 and 18 are, of course, identical. Store 8 is of rotatable design. As a result, and because the cassette robot 25 is vertically adjustable, any cassette can be moved from the store onto the turntable 30 which is designed with two recesses. It will be understood that table 30 may have a greater number of levels.

On entry, the cassettes 12 and 13 are moved into the insertion/removal position 33. As diagrammatically indicated in Fig. 3, it is possible, from this position, for example to place cassette 13 in store 8 or to transfer it directly to turntable 30.

When using so-called FOUPs, i.e. cassettes which normally close off their contents and are opened only on contact with partition 4, chamber 23 may have the same atmosphere as the surroundings, for example clean-room conditions, and does not have to satisfy the higher demands imposed when sorting the wafers for particle concentration and the like.

The device described above functions as follows. If, for example, cassette 13 which is empty is to be provided with a specific sequence of different types of wafers for treatment in, for example, a furnace, it is placed on turntable 30 using cassette-handling robot 25. Following rotation of turntable 30, cassette 13 is situated in the position of cassette 18. It is then opened. Before this, after this or simultaneously, it is ensured that a cassette containing at least one desired wafer is situated at a different level of turntable 30. For this purpose, the top part of turntable 30 can move independently from bottom part of turntable 30. Rotation of turntable 30, like the movement of the sorting device 24, store 8 and cassette-handling device 25, is controlled by control unit 20. Then, the desired

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wafer is placed in cassette 18 with the aid of wafer-handling device 24. If other wafers are required and are not present in the stock cassette used, this stock cassette is exchanged for another which may come from store 8. In this way, a desired batch is assembled in cassette 18 and is removed again using cassette-handling device 25.

5           After the treatment has finished, the cassette in question can be placed back on turntable 30 via handling device 25 and a wafer can be fed to either the top or the bottom measuring station 16 with the aid of wafer-handling device 24. In addition to a measuring station, there may also be a station for reading the wafer identification code and one for the wafer orientation. Various types of measurements on various types of test  
10   wafers or various types of measurements on the same test wafer are possible.

          The present invention considerably limits the logistics of the test wafers, since they no longer have to move along the various measuring stations and the storage/sorting device is multifunctional. In addition to advantages in the area of the housing and the atmosphere present therein, it is also possible to simplify automation,  
15   since the number of wafer-/cassette-handling robots can be limited, as can their expensive control unit 20.

          Although the invention is described above with reference to a preferred embodiment, it will be understood that numerous amendments can be made to this without departing from the scope of the present claims. For example, it is possible for the  
20   storage device to be designed in any other way which is known from the prior art. Moreover, there may be devices for determining the position of the wafer on the wafer-handling robot.

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Claims

1. Device (1) for sorting wafers which are stored in cassettes, comprising a part for receiving at least two cassettes (18, 19) and a wafer-handling device (24) for moving the wafers into and out of a cassette from and to the other cassette, characterized in that  
5 the part for receiving said cassettes is arranged in a housing (2) in which a store (8) for cassettes and a cassette-handling device (25) are arranged.
2. Sorting device according to Claim 1, in which the said wafer-handling device (24) is arranged in a chamber (22) which can be sealed off with respect to the said housing (2).
- 10 3. Sorting device according to one of the preceding claims, in which said chamber (22) comprises a measuring station (16) functionally connected with said wafer handling device.
4. Sorting device according to one of the preceding claims, in which the part for receiving at least two cassettes comprises a turntable (30).
- 15 5. Sorting device according to one of the preceding claims, in which the said store (8) for cassettes comprises a rotatable magazine.
6. Method for assembling a (part of a) batch of wafers which is to be fed to a treatment device for wafers, comprising placing at least two cassettes containing wafers in active connection with a wafer-handling device and using the said wafer-handling  
20 device to carry out a sorting operation by moving wafers from one cassette to the other and vice versa, characterized in that at least one of said cassettes is from a cassette store, said cassettes being moved from said store to the sorting station in a housing.
7. Method according to Claim 6, comprising testing said wafers during the sorting operation.

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Claims

1. Device (1) for sorting wafers which are stored in cassettes, comprising a part for receiving at least two cassettes (18, 19) and a wafer-handling device (24), the part for receiving said cassettes being arranged in a housing (2), in which a store (8) for cassettes and a cassette/handling device (25) are arranged, characterised in that, said wafer/handling device is provided for moving the wafers into and out of the cassette from and to the other cassette, and in that such store for cassette and said cassette/handling device are separated from said part for receiving cassettes.
2. Sorting device according to Claim 1, in which the said wafer-handling device (24) is arranged in a chamber (22) which can be sealed off with respect to the said housing (2).
3. Sorting device according to one of the preceding claims, in which said chamber (22) comprises a measuring station (16) functionally connected with said wafer handling device.
4. Sorting device according to one of the preceding claims, in which the part for receiving at least two cassettes comprises a turntable (30).
5. Sorting device according to one of the preceding claims, in which the said store (8) for cassettes comprises a rotatable magazine.
6. Method for assembling a batch of wafers in cassettes comprising placing at least two cassettes in active connection with a wafer handling device, said wafer handling device being used to carry out a sorting operation by transferring wafers from one cassette to the other, wherein said cassettes are from a store, and move from said store to said sorting operation by cassette handling device wherein a first cassette in the store is selected, and moved from the store to the sorting operation by said cassette handling device and a second cassette in the store is selected, and moved from the store to the sorting operation by said cassette handling device, characterised in that said first and second cassettes are moved independently from each other to said sorting operation from said store.



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7. Method according to Claim 6, comprising testing said wafers during the sorting operation.

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fig-1a

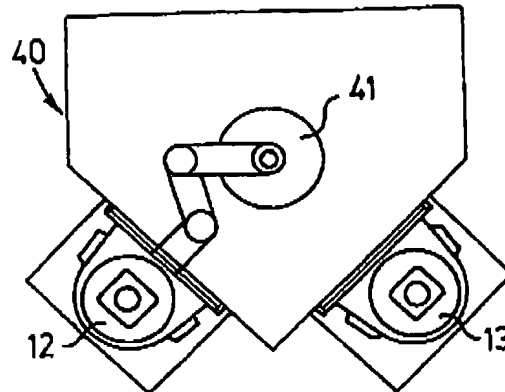


fig-1b

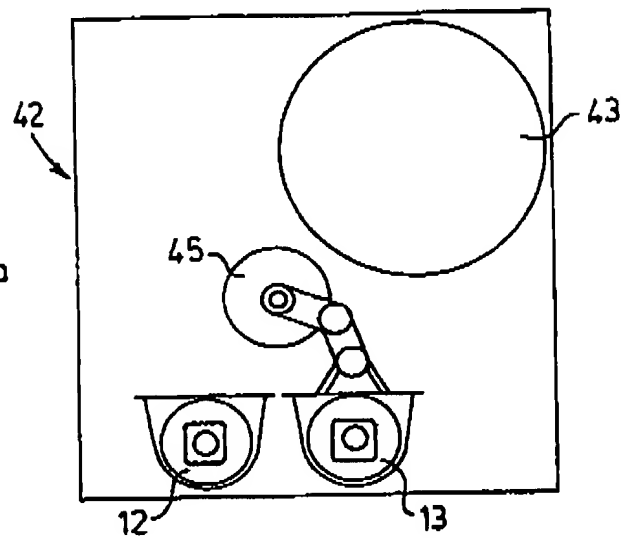
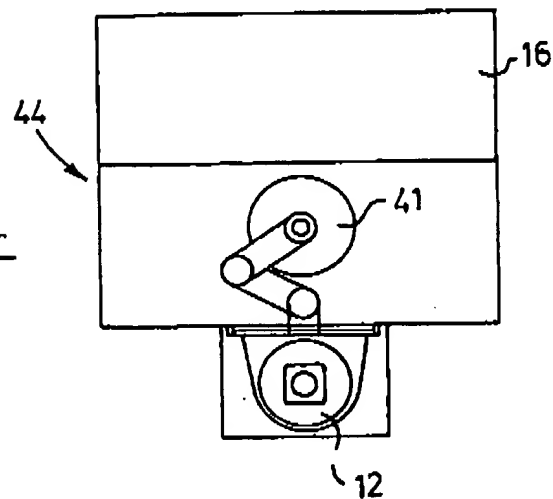


fig-1c

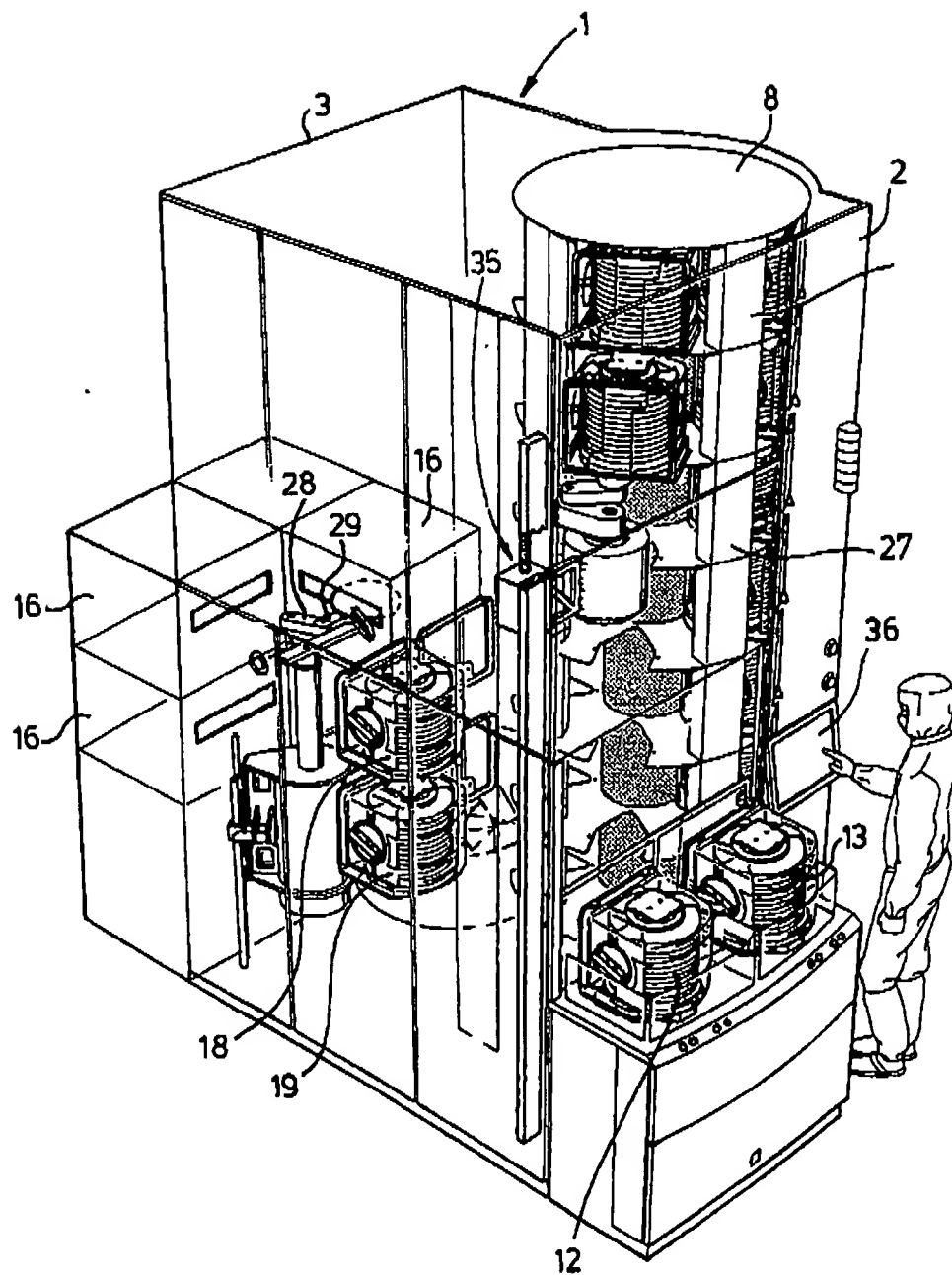


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fig-2



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